48. (Newly added) The process of Claim 44, wherein after the carbonized product has been activated in step (5), the carbonaceous material has a total pore volume ranging from 0.5 to 1.5 cm^3/g per unit mass, a volume of micropores having diameters ranging from 10 to 20 Å of from 10 to 45 % based on the total pore volume, a volume of mesopores having diameters of from 20 to 200 Å ranging from 35 to 65 % based on the total pore volume, a volume of macropores having diameters exceeding 200 Å of not more than 15 % based on the total pore volume, and a specific surface area of from 1,000 to 2,500 m^2/g.

49. (Newly added) The process of Claim 44, wherein the boiling point of the liquid thermosetting resin ranges from 180 to 350° C and the viscosity of the liquid ranges from 0.5 to 50 Pa•s.

Please amend Claim 31 as follows:

-31. (Amended) An electric double layer capacitor having electrodes comprising a carbonaceous material having a total pore volume of from 0.5 to 1.5 cm^3/g per unit mass; a volume of micropores having diameters of from 10 to 20 Å of from 10 to 45 % based on the total pore volume, a volume of mesopores having diameters of from 20 to 200 Å of from 35 to 65 % based on the total pore volume; a volume of macropores having diameters exceeding 200 Å of not more than 15 % based on the total pore volume, and a specific surface area of from 1,000 to 2,500 m^2/g.

REMARKS

Claims 25-30 and 34-37 have been cancelled. Claim 31 has been amended. New Claims 44-49 have been added. Hence, Claims 17-24, 31-33, and 38-49 are now active in this application. Reconsideration is respectfully requested.

Claim Objection

The objection to Claim 31 is resolved by the amendment made to the claim.

Claim Rejection, 35 U.S.C. 112, First Paragraph

The rejection of Claims 34, 36 and 37 is obviated by the cancellation of Claims 34-37 from the record. Withdrawal of the rejection is respectfully requested.

Claim Amendments

Basis for new Claims 44-49 can be found in previously active Claims 25-30 and by the disclosure of the text in the paragraph bridging page 12, line 24 to page 13, line 3. Entry of the new claims is respectfully requested.

Claim Ownership

All of the claims were commonly owned by the assignee at the time of the invention. As to the matter of particulars, Inventors Murakami, Mogi, Tabayashi and Shinozaki are the inventors of Claims 17-24 and 48, Inventors Shimoyama, Yamada and Shinozaki are the inventors of Claims 31-33, all six inventors are the inventors of Claims 38-43 and Inventors Murakami, Mogi and Tabayashi are the inventors of Claims 44-47.

Request For Reconsideration

As noted previously, conventional electric double layer capacitors generally contain a pair of electrodes consisting mainly of activated carbon which are formed on a current collector with a separator sandwiched therebetween, together with an electrolytic solution,

and which is sealed in a metal case by means of a metal lid and a gasket insulating the case from the lid. Conventionally, the electrodes are made of activated carbon having a large specific surface area. The capacitance of the capacitor per unit area of the electrode is greatly influenced by physical properties of both solid (electrode) and liquid (electrolytic solution). Unfortunately, the conventional capacitance per unit area of electrode remains quite low.

While it has been recognized that the pore size distribution of the activated carbon must depend to some extent upon the electrolyte ion size, it is also true that when pore sizes are too large, the pore volume becomes too high, and the energy stored per unit volume decreases.

Furthermore, it is also known that the pore structure of the activated carbon is largely determined by the nature of the carbon source, however, it has proved difficult to obtain a pore structure well-suited for an electric double layer capacitor by changing the production conditions. See page 7 of the present specification.

Advantageously, the present invention provides a carbonaceous material having a large specific surface area, and a specific pore distribution, from which a high capacitance is obtained.

Additionally, the present invention also provides, among other things, a process for producing the porous carbonaceous material, which utilizes, not only, specific process steps but also a particular liquid thermosetting resin which contains a volatile component having a boiling point of from 150° to 380°C at a viscosity of from 0.2 to 80 Pa·s at 25°C.

Claims 17-25, 29-31, 34-38 and 42-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 06-216,446 in view of JP 4-175,277. However, neither of these references, either alone or in combination, describes or suggests the present invention.

In particular, JP 06-216,446 merely describes the use of a phenolic resin as the material of activated carbon, however, fails to disclose whether the phenolic resin is liquid or solid. Additionally, the amount and viscosity of the volatile component is also unclear. Moreover, with regard to the structure of the active carbon material, the preferred specific surface area disclosed ranges from 600 to 1500 m^2/g. However, there is no disclosure of the ratios of the volumes of micropores, mesopores and macropores, based on the total volume of the pores and the pore volumes of the types of pores. Further, the pore size distribution of the active carbon material obtained must be different from the claimed carbonaceous material of the invention, because the method of production disclosed in the reference is different from the method of production of the present invention.

Still another aspect which shows the material difference between the claimed product of the invention and the product of '446 is that in the present invention, the resin employed is cured and the cured material obtained is then pulverized, followed by carbonization. On the other hand, in '446, primary activation of the carbonaceous material is conducted subsequent to carbonization, followed by grinding of the cured product. The significance of this basic difference in process is that when a material is subjected to carbonization, desorption of volatile components during the operation occurs which results in the formation of mesopores. Accordingly, if a cured product in the form of a block is carbonized such as taught by '446, mesopores are formed in a non-uniform manner. On the other hand, in the present invention where the pulverized material is carbonized, mesopores tend to be formed with uniformity. Moreover, if a cured product is carbonized without pulverization, hard charcoal forms as blocks. Subsequent pulverization then tends to be troublesome and takes a long time. Thus, there are very material differences between the present invention and that disclosed in '446.

JP 4-175,277 describes the use of a liquid phenolic resin as a material to produce activated carbon, however, an evaporation type foaming agent is mixed for treatment to thereby actively form macropores having pore diameters in excess of 200 Å. Consequently, the pore size distribution is totally different from that of the present invention.

However, in accordance with the present invention, the resin is cured and a cured product obtained is pulverized, followed by carbonization. In contrast, in JP 06-216,446, primary activation is carried out after carbonization, followed by grinding, and the reference clearly fails to either disclose or suggest grinding of the cured product itself.

Moreover, the absorption of the volatile component at the time of carbonization causes formation of mesopores, and, consequently, if a cured product in the form of a block is carbonized, the formation of mesopores tends to be non-uniform.

Alternatively, when a pulverized cured product is carbonized, formation of mesopores tends to be uniform. Further, if a cured product is carbonized without pulverization, hard charcoal in block form tends to be obtained, and the following pulverization tends to be troublesome and lengthy.

In accordance with JP 4-175,277, a formed sheet is cured and carbonized which is used as an electrode "as is". In contrast, in accordance with the present invention, an activated carbon is used which is formed together with a binder to prepare a sheet electrode.

Attention is now directed to the examples and comparative examples of the present specification in order to clearly demonstrate the unobviousness of the present invention.

In order to clearly see the importance of using the volatile component of the present invention having a particular boiling point range and viscosity range, attention is directed to Comparative Examples 1, 2, 4 and 9. Specifically, in Comparative Example 1, the volatile

component has a viscosity of 0.08 Pa·s, whereas in Comparative Example 2, the volatile component has a viscosity of 120 Pa·s. That is, in Comparative Example 1, the viscosity is below that required in accordance with the present invention, whereas in Comparative Example 2, the viscosity is above that required by the present invention.

In Comparative Example 4, the volatile component has a boiling point of from 390° to 460°C, which is higher than that required by the present invention. Additionally, in Comparative Example 9, a curing agent is not used, unlike that of the present process.

The results of these aberrations are clear from Table 1. Notably, in Table 1, Comparative Example 1 affords an amount of mesopores which is below that of the present invention. Comparative Examples 2 and 4 also afford too few mesopores as compared to the present invention. Comparative Example 2 also provides a pore volume which is that below that of the present invention, whereas Comparative Example 9 affords a pore volume which is too high relative to the present invention.

Furthermore, in all of Comparative Examples 1, 2, 4 and 9, the capacitance obtained is too low and the internal resistance (electrical resistivity) is much higher than that of the present invention. These are results that the present invention seeks to avoid.

Thus, there is a direct influence of the boiling point and viscosity of the volatile component on the resulting pore structure of the carbonaceous material produced. It is quite clear that the pore characteristics of the present carbonaceous material are not inherent in any of the references cited by the Examiner.

It should also be noted that in "277, a sheet is cured and then carbonized. The sheet is used as is as an electrode, whereas in the present invention an activated carbon powder is obtained and the carbon powder obtained is formulated with a binder to form a sheet

electrode. This very material difference in process is another indicator of the non-trivial distinction between the present invention and the '277 disclosure

Furthermore, it is equally clear that the presently claimed pore structure is required in order to obtain the desired electrical properties for the present electric double layer capacitor.

Clearly, none of the cited references would place one skilled in the art in possession of the present invention.

Hence, this ground of rejection is believed to be unsustainable and should be withdrawn.

Claims 17-31 and 34-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 06-216,446 in view of JP 4-175,277 and in further view of JP 5-243,092 and JP 2-297,915. However, the latter two cited references clearly fail to correct the deficiencies of the two former cited references.

Specifically, neither of the latter two cited references describe or suggests the use of the particular liquid thermosetting resin in the present invention in the formation of a porous carbonaceous material used in an electric double layer capacitor. The results of this omission are clear from above.

Hence, this ground of rejection is believed to be unsustainable and should be withdrawn.

Claims 17-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 06-216,446 in view of JP 4-175,277 and in further view of JP 5-243,092 and JP 2-297,915, and further in view of U. S. Patent 5,754,393. This ground of rejection is respectfully traversed.

The rejection is traversed for the same reasons as advanced in the two grounds of rejection raised under 35 U.S.C. 103 above. Moreover, the '393 patent does not suggest a carbonaceous material having the pore characteristics of the present carbonaceous material.

Accordingly, in view of all of the above, it is believed that the present application now stands in condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Norman F. Oblon
Attorney of Record
Registration No. 24,618

Frederick D. Vastine
Registration No. 27,013

22850
Tel. (703) 413-3000
Fax. (703) 413-2220
(OSMMN 11/98)

MARKED-UP COPY OF AMENDMENT

IN THE SPECIFICATION

Page 46, line 20 to page 47, line 6, delete the paragraph in the entirety, and insert therefor:

(1) To the phenolic resin A of Example 1, 0.5 mass % of hexamethylenetetramine as a curing agent was added to obtain a liquid resin R having a viscosity of 4.5 Pa·s at 25°C. A carbonaceous material R was obtained from the resin R under the same condition as in Example 1. The mass reduction till 400°C in the carbonization was 27 mass %. Of the activated carbon, the specific surface area was 1,050 m^2/g, the total pore volume was 0.75 cm^3/g, the ratio of the volume of pores having diameters of from 10 to 20 Å was 18 % based on the total pore volume, the ratio of the volume of pores having diameters of from 20 to 200 Å was 61 % based on the total pore volume, and the ratio of the volume of pores having diameters exceeding 200 Å was [3%] 21 % based on the total pore volume.

Page 49, please amend Table 1 (continued) to read:

Table 1 (continued)

	Ratio of pore volume based on the total pore volume			Total pore volume (cm^3/g)	Specific surface area (m^2/g)	Capacitance (F)	Internal resistance (Ω)
	10-20 Å	20-200 Å	Over 2000 Å				
Comparative Example 1	24	10	1	0.73	1500	2.65	12.2
Comparative Example 2	20	8	2	0.41	900	1.13	10.2
Comparative Example 3	20	4	1	0.70	1600	2.80	13.5
Comparative Example 4	25	5	1	0.89	2050	2.85	11.5
Comparative Example 5	15	2	0.5	0.64	1300	1.95	15.5
Comparative Example 6	9	65	22	2.55	1200	1.54	27.5
Comparative Example 7	21	8	2	0.85	1800	2.26	9.5
Comparative Example 8	8	65	17	2.51	1750	1.39	24.3
Comparative Example 9	18	60	[25] 20	1.61	1500	2.1	19.5
Comparative Example 10	18	61	21	0.75	1050	1.32	22.5

IN THE CLAIMS

25-30. (Cancelled).

34-37. (Cancelled).

--44. (Newly added) Process for producing a porous carbonaceous material, which comprises the steps of:

(1) curing a liquid thermosetting resin which contains a volatile component having a boiling point of from 150° to 380° C and which has a viscosity of from 0.2 to 80 Pa·s at 25° C to obtain a cured product;

(2) adding at least one percent of a curing agent;

(3) pulverizing the cured product;

(4) carbonizing the pulverized cured product in a non-oxidizing atmosphere so that the mass reduction till 400°C and the carbonization is from 2 to 50 mass % of the mass before carbonization, to obtain a carbonized product; and

(5) activating the carbonized product.

45. (Newly added) The process of Claim 44, wherein after the addition of curing agent, kneading is effected and then a curing accelerator is added thereto, wherein after kneading is effected and then the kneaded product is cured to obtain a cured product.

46. (Newly added) The process of Claim 44, wherein the currant accelerator is added in an amount of at most 5 mass % based on the thermosetting resin.

47. (Newly added) The process of Claim 44, wherein the thermosetting resin is a phenolic resin.

48. (Newly added) The process of Claim 44, wherein after the carbonized product has been activated in step (5), the carbonaceous material has a total pore volume of from 0.5

to 1.5 cm^3/g per unit mass, a volume of micropores having diameters of from 10 to 20 Å of from 10 to 45 % based on the total pore volume, a volume of mesopores having diameters of from 20 to 200 Å of from 35 to 65 % based on the total pore volume, a volume of macropores having diameters exceeding 200 Å of not more than 15 % based on the total pore volume, and a specific surface area of from 1,000 to 2,500 m^2/g.

49. (Newly added) The process of Claim 44, wherein the boiling point of the liquid thermosetting resin ranges from 180 to 350° C and the viscosity of the liquid ranges from 0.5 to 50 Pa•s. --

Please amend Claim 31 as follows:

--31. (Amended) An electric double layer capacitor having electrodes comprising a carbonaceous material having a total pore volume of from 0.5 to 1.5 cm^3/g per unit mass; a volume of micropores having diameters of from 10 to 20 Å of from 10 to 45 % based on the total pore volume, a volume of mesopores having diameters of from 20 to 200 Å of from 35 to 65 % based on the total pore volume; a volume of [macro res] <u>macropores</u> having diameters exceeding 200 Å of not more than 15 % based on the total pore volume, and a specific surface area of from 1,000 to 2,500 m^2/g.--